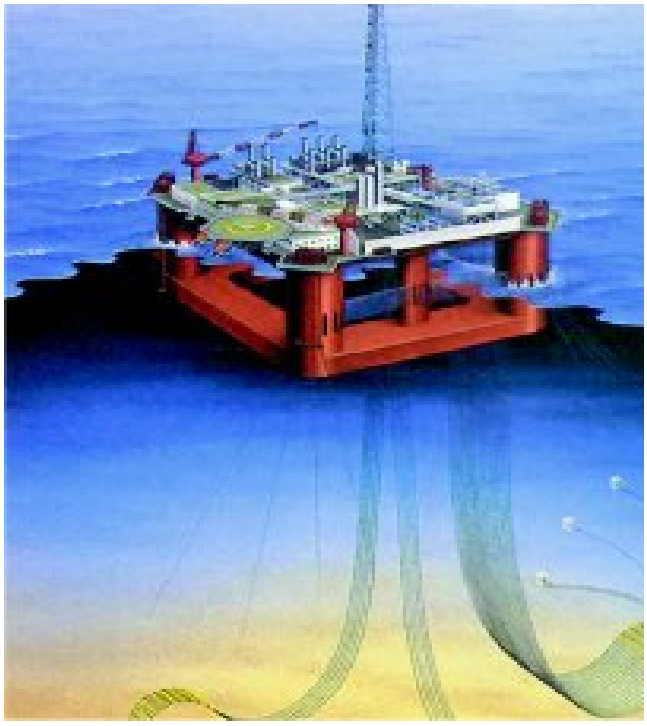
Integrity Management for Optimal Service Life

Flexible Pipe Integrity



A full service provider

Specialist knowledge and understanding of integrity issues and their operational implications are necessary to maintain the integrity of a flexible pipe system.

FORCE Technology Norway AS has spearheaded the development of inspection and monitoring technology for flexible pipes and possesses the knowledge and techniques for flexible pipe integrity management.

We achieve cost effective integrity management through application of Risk Based Inspection (RBI) strategies, combined by a detailed knowledge of the inspection and monitoring technology available.

Services and products

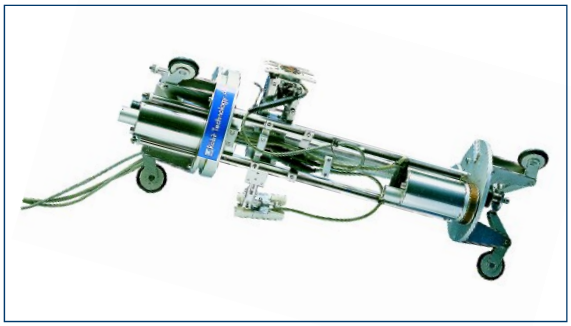
The FORCE Technology Norway AS product range comprices:

- Video based visual inspection
- Eddy current inspection of steel armour
- Monitoring systems for polymer ageing with bare and instrumented probes
- Polymer material condition assessment; analysis with regards to molecular weight and mechanical properties
- Monitoring of the annulus vent gas
- Developing and performing a RBI based inspection and monitoring program for optimal service life
- Monitoring of motion, strain and curvature, see separate data sheet.

Inspection and Monitoring Techniques

Visual and Video Based Inspection

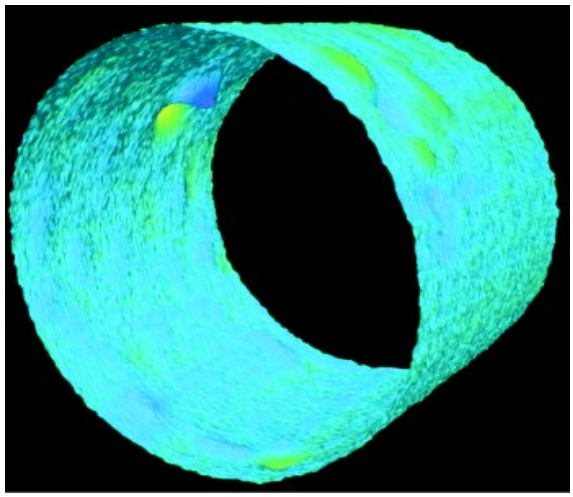
Internal pipe video inspection tools available from FORCE Technology Norway AS make it possible to visually inspect the carcass and the endfitting integrity of flexible pipes. This is relevant in cases where one expects corrosion of the carcass, erosion due to sand production, or in some endfitting designs where the integrity can be checked by measuring the gap between the carcass and the endfitting body.



Eddy Current Inspection of Steel Armour

FORCE Technology Norway AS supplies commercial inspection of the carcass, the hoop strain armour or the tension carrying armours in unbonded flexible pipes. Most focus is on inspection of the hoop strain armour in the region where dynamic loads are expected to be high and fatigue is an issue, such as the bendstiffener or bell-mouthed area.

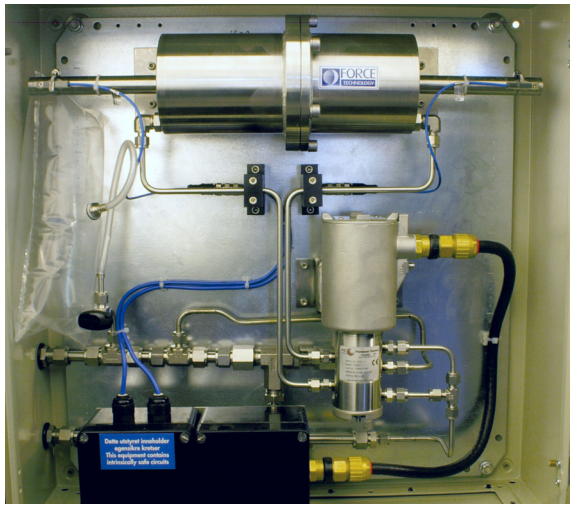
Typical diameter ranges are from 7.4” to 16” inner diameter. The detection capabilities are design dependent, particularly with distance to the hoop strain armour and material in the carcass. Modification of the standard tools may allow inspection under pressure or in atmospheres with explosion hazard.



Annulus Vent Gas Monitoring

The inner polymer liner of a flexible pipe is permeable to gases giving rise to an annulus vent gas rate. Knowledge and monitoring of the vent gas flow can be used as a method to limit damages and consequences in case of an integrity loss in either the pressure sheath or the annulus.

FORCE Technology Norway AS has a unit for monitoring the vent gas flow from the annulus of flexible pipes. It measures total volume and rate of the vented gas, and can monitor the annulus integrity (seawater ingress). The monitoring unit provides sampling points of the vented gas for compositional analysis in a suitable laboratory.



Minimum size 600 x 600 x 207 mm

Motion and Strain

Motion, curvature and dynamic response are monitored using the expert knowledge FORCE Technology Norway AS has about flexible and rigid risers and offshore structures. A separate brochure is available for the products and services within Riser Monitoring.

Polymer Monitoring and Analysis

Polymer Monitoring and Service Life Evaluation

The product range comprises bare and instrumented polymer coupons. Both types are for insertion into 2" ID access fittings, hydraulic or mechanical.

The access fitting technology allows coupon removal during full production, at the same time as sufficient sample quantities are made available for a reliable analysis. This is an issue for an operator, since the workload during shutdowns is so high that planned material retrieval may be postponed or called off.

Applicable products are:

- PVDF and XLPE polymer material:
  - Coupons for thermal cycle loading (crack propagation)
  - Tensile test pieces bars and strips.
- PA11 material (Rilsan):
  - Disk coupons for molecular weight analysis
  - Instrumented sensors (FDEMS technology in an intrinsically safe unit)
  - Integrated and dedicated temperature sensors.

Instrumented coupons enhance the monitoring, relating rate of ageing to specific operations of the pipe and increase the resolution in the measure-ment.

(From left, clockwise) Instrumented coupon, fitting, logger unit (Eex appr.), hand held interrogation unit

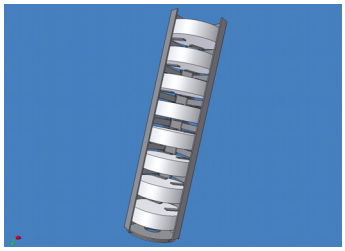
Instrumented coupon complete with hydraulic plug and cover

Material Analysis and Service Life Assessment

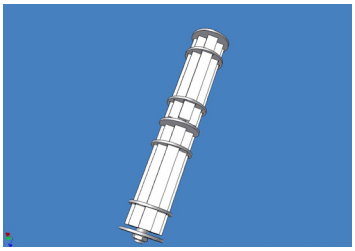
Laboratory test facilities include:

- Molecular weight (3 independent, small sample accurate and reliable methods)
- Density, volume, hardness, plastiziser and volatile content
- Tensile properties
- Service life assessment and expert assistance in evaluation of the use of polymers in flexible pipes.

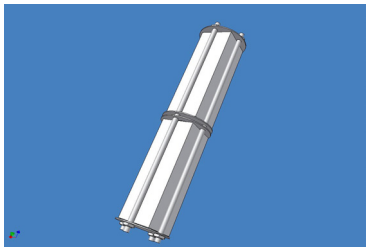
Pre-stressed 2" coupon



***A)** Disc cpupons: Typically 8-10, well spaced, full exposure all sides*



***B)** DMTA coupons: 16 pieces, well spaced, full exposure all sides*



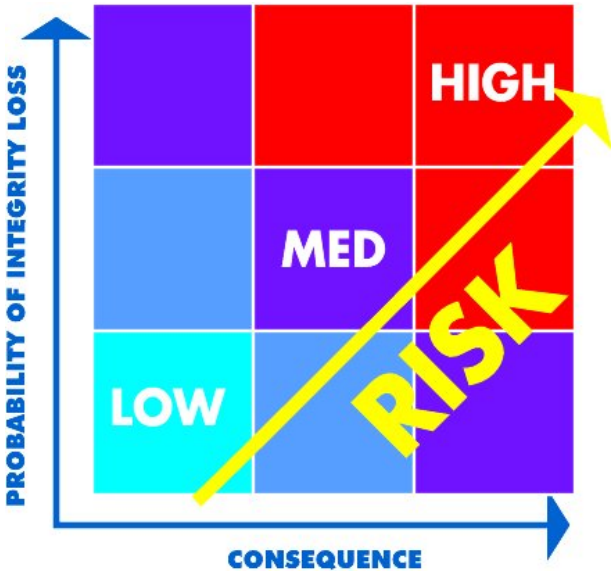
***C)** Bar coupons: 8 pieces, 1 mm clearing between sides*

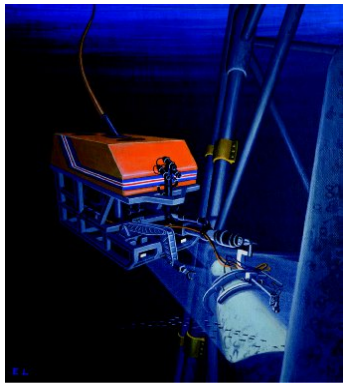
Risk Based Inspection and Monitoring

FORCE Technology Norway AS has extensive experience in developing risk based inspection and monitoring strategies for unbonded flexible pipe systems. We apply the processes described in *"Guidelines for integrity monitoring of unbonded flexible pipes".*

Data base tools are used to keep track of the risk assessment, store the background information relevant for the inspection and monitoring strategy, and the evaluations made in the process, for easy updates as the pipe system gains experience.

The work is done in close co-operation with experts in the operator company, in order to reach a strategy and an inspection program that reflects the philosophy adopted by the operator.





Reference List

- Petro Canada
- Chevron
- Total
- Norsk Hydro
- Petrobras
- Woodside.

Further information: FORCE Technology Norway AS
Pål Tuset, tel. (direct) +47 64 00 35 12, ptu@forcetechnology.no

FORCE Technology USA Inc.
Tel. +1 713 975 8300
FORCE Technology Rusland LLC
Tel. +7(812) 326 80 92

FORCE Technology Norway AS
Claude Monets allé 5
1338 Sandvika, Norway
Tel. +47 64 00 35 00
Fax +47 64 00 35 01
info@forcetechnology.no

FORCE Technology Sweden AB
Tallmätargatan 7
721 34 Västerås, Sweden
Tel. +46 (0)21 490 3000
Fax +46 (0)21 490 3001
info@force.se

FORCE Technology, Headquarters
Park Allé 345
2605 Brøndby, Denmark
Tel. +45 43 26 70 00
Fax +45 43 26 70 11
force@force.dk
www.forcetechnology.com